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ABSTRACT

As part of a Feelin' Good intervention program to improve the physical fitness of children in grades 2 through 4, 603 students were tested for muscle strength and flexibility. Complete pre- and posttest data were obtained from 388 students. Two muscle strength tests and two flexibility tests demonstrated consistent sex differences in performance. Three muscle strength tests demonstrated grade level differences: older girls outperformed younger girls. Fourth grade boys exhibited a pattern of depressed performance on two flexibility tests. Using McNemar's (1969) test of the differences of correlated proportions, performance changes from pre- to posttest were assessed. Both boys and girls showed significant improvement on two muscle strength tests and two flexibility tests. Results indicate a pattern of improvement in performance from pre- to posttest. It was concluded that intervention programs make a difference, but schools should not be dependent upon outside sources to teach health and physical education. (Author/RH)

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HOW FIT ARE ELEMENTARY CHILDREN IN GRADES 2-4?

by

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ABSTRACT

As part of a Feelin' Good intervention program to improve the physical fitness of children in grades 2-4, 603 students were tested for muscle strength and flexibility. Complete pre and posttest data were obtained from 388 students. The results show that two muscle strength tests and two flexibility tests demonstrated consistent sex differences in performance. Three muscle strength tests demonstrated grade level differences with older girls out performing younger girls. Fourth grade boys exhibited a pattern of depressed performance on two flexibility tests. Using McNemar's test of the differences of correlated proportions, performance changes from pre to posttest were assessed. Both boys and girls showed significant improvement on two muscle strength tests and two flexibility tests. Results indicate a pattern of improvement in performance from pre to posttest. It was concluded that intervention programs make a difference, but schools should not be dependent upon outside sources to teach health and physical education.

How Fit Are Elementary Children in Grades 2-4?

Introduction

An effective physical education program needs to be taught at least three days per week and each session should allow at least 30 minutes of fairly intensive exercise so that students work at approximately 70% of their cardiovascular capacity. The basic purpose of physical education is to provide students with movement experiences; the underlying goal is optimal growth and development consistent with each individual's characteristics, interests, and abilities. Physical educators typically define fitness in terms of physical performance which is determined by testing muscular strength, muscular endurance, flexibility, circulo-respiratory endurance, and body weight and composition.

The bleakness of the elementary physical education program and the dismal physical condition of elementary students are probably two of the best kept secrets in education. With the emphasis on the so-called "basics," physical education like social studies, science, and the arts has been all but forgotten. Many elementary teachers consider physical education as an "add-on" or a free time play period. As a consequence other subjects take precedence in both teaching time and planning time, and if students misbehave, then "play time" is used as a punishment period to make up other work.

The lack of planned physical education activities for young students has far-reaching consequences for both students and for society. For some time now both medical and physical educators have been convinced of a relationship between debilitating diseases and lack of exercise. Obesity, cardiovascular disease, and stress related illnesses have been identified by researchers as commencing during childhood.

Heart Disease. Studies by Gilliam (1977, 1978) and other researchers indicate that there has been an alarming incidence of heart disease among elementary children between the ages of 6 and 13 years. Children as well as adults seem to live a sedentary life style and school physical education programs do not provide vigorous activities to challenge students and reduce the risk of coronary disease. Hovell, Bursick, Sharkey, and McClure (1978) studied students' voluntary physical activity during recess time and found that elementary children obtain very little exercise during recess periods. Compared to adult standards, the children engaged in half as much activity as adults. Hovell and colleagues concluded that "children are not as physically

fit as might be" (p. 472). Pels, Geenen, Kuntzleman, Dodson, Kuntzleman, and Gilliam (1978) studied the activity pattern of boys in grades 2, 5, and 7 and concluded that none of the children were active enough to produce cardiovascular fitness. In a New York State Education Department report (1978) physicians stressed that cardiovascular disease was the result of a process begun during the childhood years, and Boyer (1974), Wilmore and McNamara (1974) and other researchers found a high incidence of elevated blood lipids, obesity, hypertension, and low work capacity as indications that coronary heart disease may be a childhood problem.

Obesity. Rose and Mayer (1968) found a relationship between weight and activity level and between triceps skinfold thickness and activity. Mayer (1974) and Lauer, Connor, Leaverton, Reiter, and Clarke (1975) have reported that 20% of the students 6 to 9 years of age in the population investigated had excess body fat. Body fat contributes to overweight problems and percent of body fat increases with age, especially for girls(Richardson, Weinberg, Bruya, Bavn, Jackson, Caton, and Bruya, 1980). Richardon and colleagues warned that the chubby child frequently turns into the fat adult with coronary heart disease problems.

Stress. Poor body conditioning and muscle weakness are thought to be responsible for about 80% of all adult back pain problems. Contributing factors are tension and poor posture, both of which can be treated by exercise (Kraus, 1965). Adult physical fitness and life style are dependent to a great degree on flexibility, endurance, and strength developed in childhood. Boys are frequently less flexible than girls and Gallahue (1976) attributes lack of activity as the cause of diminished flexibility in later childhood.

Muscle Strength and Flexibility. The six Kraus-Weber tests were designed for all age groups and reveal whether the key muscle groups of the body can handle body weight and have the flexibility to match the body's height. The tests were medically validated at the Presbyterian Hospital in New York City and administered world-wide to children ages 6 to 19. In the United States school children in suburban and small urban communities were tested. 57.9% of the American children failed one or more of the six tests while only 8.7% of the European children failed one or more of the tests. On the flexibility test (Test 6) 44.3% of the American children failed as compared to 7.8% of the European children. On the five muscle strength tests, 35.7% of the American children failed one or more of the tests as compared to 1.1% of the European children (Kraus, 1965, p. 41). Kraus and Prudden (1953) after reviewing the test results concluded that insufficient exercise could cause a lowering of muscle efficiency needed for daily living and be a factor in nervous tension.

The American Alliance for Health and Physical Education and Recreation (AAHPER) administered physical fitness tests to older students in grades 5-12 in 1965 and again in 1975. Comparison of the results indicates that students, in general, did not improve in their performance; both the 1965 results and the 1975 results clearly show that students were not in good physical condition (Hunsicker and Reiff, 1976).

Intervention Projects

Physical and medical educators and researchers united to obtain additional information about children's physical fitness and to counteract some of the aforementioned problems. Several exemplary programs were developed to encourage children to exercise and to provide

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children with knowledge about cardiovascular health and nutrition.

Project Superheart developed in 1977 was designed as an intervention program. The physical fitness aspect of the program included aerobic games and activities to raise the heart rate to a target level and sustain the rate for 15 minutes. Children were taught to measure their own heart rate and to record their findings. Knowledge components of the program included information about nutritional habits and cardiovascular health. Demonstrations were provided on cardiovascular anatomy and physiology, and the role of good nutrition and physical fitness in the maintenance of general cardiovascular health. Project Superheart was funded through ESEA Title IV-C grant from the New York State Education Department (Way, 1981).

Project Sunflower was a three year program funded by the University of Kansas Department of Health, Physical Education, and Recreation, the University of Kansas Medical School, the Shawnee Mission Kansas School District, the American Heart Association and the American Lung Association in Kansas. The project incorporated a cardiopulmonary fitness program which included instruction in heart health, pulmonary health, nutrition, and physical fitness. The fitness period stressed aerobic activity to increase students' physical endurance. Parents and teachers were included in the project and the results indicated that the program lowered the cholesterol levels, blood pressure, and resting heart rate while increasing physical endurance of the participating students (Greene, 1980).

The Feelin' Good program, initiated in 1973, is a project of the National YMCA. Although designed for grades K-9, the project

is typically taught by YMCA leaders in the elementary schools. The curriculum project integrates health and physical education and tries to relate cognitive concepts to other areas of the elementary curriculum. There are ten program objectives which include an emphasis on physical fitness and understandings related to coronary risk factors and total fitness. The classroom component of the program provides information on the cardiovascular system and the impact of smoking, nutrition, obesity, stress, hypertension, and exercise. The activity component emphasizes cardiovascular fitness by providing a workout that is of a continuous endurance nature. The children are taught to take their pulse rates, and body changes due to exercises are noted. As originally planned the program should be taught for 30 minutes, two days per week with ten minutes devoted to the classroom lessons and twenty minutes devoted to the activity component. Each YMCA branch utilizing the Feelin' Good program is responsible for obtaining funding for the project.

What Do We Know About Children's Fitness?

Medical specialists describe fitness in terms of freedom from disease. Physical educators describe fitness in terms of the individual's physical performance. Physical educators determine fitness by testing muscular strength, muscular endurance, flexibility, circulo-respiratory endurance, and body weight and composition. Both medical educators and exercise physiologists have related a lack of exercise with debilitating diseases. The onset of these illnesses could begin during the childhood years. Fitness assessments have focused on blood composition (cholesterol, triglycerides, hemoglobin), blood pressure, heart rate, body composition, pulmonary

function, and endurance testing through a running or jogging activity. Review of the research reveals that approximately 60% of United States children do not participate in a daily program of vigorous physical activity (Bucher, 1975).

The Kraus-Weber muscular strength and flexibility study was the only national effort to test young elementary school aged children. That study is now thirty years old. The researchers concluded that American children were weak, tense, and under-exercised. The last test battery for children in grades 5-12 was administered by AAHPER in 1975. Since that time we have no national data. For students below the 5th grade there is only spotty information from the intervention projects related to weight, exercise habits, blood composition, and heart rate.

Purpose of This Study

The Feelin' Good program in Los Angeles was funded by the Metropolitan YMCA and the American Heart Association of Los Angeles. Mid Valley YMCA serviced 1200 students in grades 2-4. No information was available concerning the students' muscle strength or flexibility. This study was initated to (1) test minimal muscle strength and flexibility of students in grades 2-4 using the Feelin' Good population; (2) judge the most desireable ways to utilize the Feelin' Good program to improve physical fitness.

Method

Tests. Using a trained team of lay and professional YMCA personnel, thirteen physical fitness tests were administered in October, 1981, and readministered as a posttest in March, 1982. The tests included the six Kraus-Weber minimal muscle strength and flexibility tests, six optimum flexibility tests and one optimum strength test as described by Prudden (1977).

Kraus-Weber Tests

1. Abdominals plus Psoas
   Straight leg sit-up, hands behind neck, examiner holds ankles.
2. Abdominals minus Psoas
   Bent knee sit-up, hands behind neck, examiner holds ankles.
3. Psoas
   Body at full stretch, lie supine, hands behind neck, lift legs 10 inches off of floor
4. Upper Back
   Lie prone, hands behind neck, lift head and chest and hold for 10 seconds. Examiner holds legs steady.
5. Lower Back
   Lie prone with arms under head, lift legs until thighs are off of floor; hold for 10 seconds. Examiner holds back steady.
6. Back and Hamstring Flexibility
   Standing with feet together and knees straight, lean over slowly and touch the floor with finger tips.

Optimum Flexibility Tests and Optimum Strength Test

7. Spread-Leg Ear to Knee
   Legs in straddle position, place ear to knee without bending the leg.
8. Crotch Stretch, Head to Feet
   Back stretch; sitting on floor, bend the knees and place feet sole to sole; touch forehead to toes without pulling feet upward.
9. Crotch Stretch, Knees to Floor
   Back stretch and flexibility ingroin; sitting on floor, grasp ankles and use elbows to push both knees downward, evenly, in order to place outside of knees flat on the floor.

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10. Soleus Stretch - heel cord
    Placing the feet parallel about three inches from a wall and keeping heels flat on the floor, touch knees to wall.

11. Shoulder Flexibility
    Reach right arm down the back and left arm up the back to make hands meet; repeat with left arm going down the back and right arm up the back.

12. Vital Capacity (This test was discarded.)
    Blow all the air from the lungs and measure the size of chest. Inhale and expand to fullest extent. Measure again. Vital capacity is the difference in inches from full exhalation to full inhalation. Expansion should be at least three inches.

13. Pushups (Optimum Strength Test)
    Body is held rigid, feet together, hands shoulder level. Push up until arms are straight, lower slowly. When body is at rest the hands are brought up to touch over the back.

Students were required to perform the exercise tests just once; each test was judged pass or fail. Procedure during testing was as follows:

(1) Students were tested individually.
(2) Before each test the student was given directions by the examiner.
(3) If the student appeared not to comprehend the directions, the examiner demonstrated the exercise.
(4) If the student performed the exercise with a "substitution" he/she was asked to repeat the test so the examiner could verify that the student was unable to perform the test correctly. A substitution was defined as performing a test and adding a deviation as when the student would lead with the elbows when performing a bent knee sit-up.

Subjects. 603 students were tested in the program, but complete data were obtained from only 388 students. Testing was done in four

schools. One of the schools had an 85% minority enrollment. In that school, only second graders were tested. The other three schools had minority enrollments of 50% to 67%.

Boys		Girls	
2nd grade	91	106	2nd grade
3rd grade	45	52	3rd grade
4th grade	53	41	4th grade
	189	199	

Intervention. Observational data obtained during the pre-test situation were used to suggest corrective exercises to the Feelin' Good instructors. Corrective exercises for the Kraus-Weber tests included bent knee sit-ups, spine down stretch with the cat back, swimming and rowing exercises, cat back and arm and leg lifts in opposition, peanut push. For tests 7-13 the following corrective exercises were suggested: the swim, thigh stretch (elbows up), waist twist, bent over waist twist, side bends backstroke.

Although the Feelin' Good program is supposed to be taught two days per week, funding was inadequate. As a consequence the program was taught only once per week for 30 minutes. The thirty minutes included both the classroom teaching component and the activity component. The workout format for the activity component featured non-competitive, continuous, endurance exercise. Included were relays, aerobic games, jump rope activities, circuit training, perceptual motor skills along with the corrective exercises.

It was suggested to some of the classroom teachers who openly expressed interest in the program that they reinforce the physical fitness activities at least one additional day each week. There is no

information available as to whether or not the activities were reinforced.

Results

The results are reviewed in three sections. The first section focuses on performance differences between boys and girls. Section two reports differences among second, third and fourth graders. The third section examines changes in individual performance from the pretest administration to the posttest. Tests 1-5 and test 13 measured minimum muscle strength; tests 6-11 measured flexibility. The test for vital capacity (Test 12) was discarded because the children did not appear to understand the directions. Table 1 presents pretest and posttest data by sex and grade level for the six muscle strength tests. Table 2 presents pretest and posttest data by sex and grade level for the six flexibility tests.

Sex Differences in Performance

Test 13 (push-ups) demonstrated consistent sex differences in performance. At pretest the boys outperformed the girls in each grade level (grade 2 $x^2 = 25.64$, $p<.001$; grade 3 $x^2 = 6.13$, $p<.01$; grade 4 $x^2 = 4.95$, $p<.05$). Second and third grade boys again outperformed the girls on pushups at posttest (grade 2 $x^2 = 3.95$, $p<.05$; grade 3 $x^2 = 5.70$, $p<.05$). There was no sex difference in the push-up pass rates of fourth graders at posttest.

One additional sex difference in muscle strength was found. At posttest, among third graders, boys performed bent knee sit-ups better than girls ($x^2 = 4.07$, $p<.05$).

Table 3 presents x^2 's pretest and posttest data by sex and grade level for the six flexibility tests. Of the thirty-six x^2's calculated, fourteen showed significant sex differences, with girls outperforming boys in each instance. There was at least one significant sex difference in performance on each of the six flexibility tests.

Two flexibility tests showed pervasive sex differences; spread leg ear to knee (in second and third graders at both pretest and posttest) and head to feet crotch stretch (in each grade at pretest and in grades two and four at posttest).

Performance Differences By Grade Level

Three of the muscle strength tests demonstrated some grade level differences. In two of the tests these differences were found only in the sample of girls. In each of these three tests children in higher grades ourperformed children in lower grades.

On the straight leg sit up at pretest, performance differed by grade level for both boys and girls, with second graders' performance significantly depressed (x^2 - 22.88, $p<.001$, boys; x^2= 18.71, $p<.001$, girls). On the bent knee sit up at posttest, the girls' performance differed by grade level, with fourth grade performance elevated (x^2= 6.58, $p<.5$). At pretest, the girls' performance on pushups differed by grade level (x^2= 7.99, $p<.05$).

Table 4 presents x^2 s testing sex and grade level differences in performance of the six flexibility tests in pretest and posttest. Of the twenty-four x^2s calculated eight showed significant grade in school differences.

The spread leg ear to knee test showed no grade level performance differences. In two tests, back and hamstring flexibility and the crotch stretch , head to feet, the significant differences involved depressed performance by fourth graders; this pattern of poorer performance in higher grades was found only in boys. All other instances of significant grade level differences involved depressed performance by second graders.

The only flexibility test to show significant grade level differences in both boys and girls was the shoulder flexibility test.

Performance Changes

McNemar's test of the differences of correlated proportions (McNemar, 1969) was used to assess changes in performance from pretest to posttest. Table 5 presents the resulting z's on the muscle strength tests for boys and girls separately in each of the three school grades. Table 6 presents comparable information on the flexibility tests. In each instance of significant change, the direction was that of improved performance at posttest over pretest.

Both boys and girls at each grade level showed significant improvement on two muscle strength tests, bent knee sit-ups (abdominals minus Psoas) and push-ups.

Second grade children improved on straight leg sit-ups (abdominals plus Psoas). The third and fourth grades had pass rates at pretest of 80%+ on average, limiting possibility for improvement.

Girls at each grade level improved on the leg lift (Test 5). Fourth grade boys also showed significant improvement on this test. This was a test with an average pass rate at pretest of more than 75% and a test on which there were no significant sex or grade in school differences.

Boys at each grade level improved on the head and chest lift (Test 4), from high (85%+) pretest pass rates.

Two flexibility tests, back and hamstring flexibility (Test 6) and head to feet crotch stretch (Test 8), showed a general pattern of improvement at posttest for both boys and girls. Each of these tests showed low (under 50%) pass rates at pretest, particularly low for fourth grade boys.

Girls at all grade levels and third grade boys improved on the soleus stretch (Test 10).

Discussion and Conclusions

Sex Differences

It was anticipated from the review of research that boys might be less flexible than girls but exhibit greater muscle strength. Our findings generally supported this expectation. At the 2nd and 3rd grade levels the boys exhibited far greater muscle strength as demonstrated by their performance of the push-ups (Test 13). Third grade boys exhibited superior muscle strength in their performance of the bent knee sit-ups (Abdominals minus Psoas, Test 2).

Significant evidence of sex differences in flexibility was recorded in all six of the flexibility tests, and these differences in performance may have occurred earlier in the elementary school years than previously anticipated. Both on the spread leg ear to knee (Test 7) and the crotch stretch head to feet (Test 8) sex differences favoring the pass rate of girls were prevalent.

Grade Level Differences

As students advanced in grade level their performance on the tests of muscle strength consistently improved. However, the flexibility tests did not show a similar trend. On the back and hamstring

flexibility test (Test 6) and the head to feet crotch stretch (Test 8) boys performed significantly poorer than girls. The depressed performance of 4th grade boys supports the existing research base that as boys get older they become less flexible. Only on the test for shoulder flexibility did differences in age favor older children, except for 4th grade boys, who performed poorer than the 3rd grade boys.

Kraus-Weber Tests (Tests 1-6)

Kraus and Prudden (1953) reported the percent of children failing one or more tests at age 7 was 78%, for 8 year olds, it was 65%, and for 9 year olds, it was 68%. In this study 92% of the 2nd graders (7 years old), failed one or more tests, 88% of the 3rd graders (8 years old) failed one or more tests, and 84% of the 4th graders (9 years old) failed one or more tests.

It is reasonable to assume that the Northeastern United States suburban and small urban population studied by Kraus and Prudden in 1952 differed considerably from the population of this study. More than 50% of the subjects of this study were of racial or ethnic minority status. Although the populations may differ, it is still apparent that the state of physical fitness for 7-9 year olds has deteriorated.

Pattern of Improvement

Four of the six items measuring minimum muscle strength show a pattern of improvement in performance from pretest to posttest. These four are the bent knee sit-up (Abdominals minus Psoas, Test 2), leg lifts (Psoas, Test 3), the head and chest lift (Upper back, Test 4), and the push-ups (Test 13). The pass rates for these items shown in Table 1 suggest that the improvement seen is not due to simple maturation. There are no significant differences by grade level on any of these items. On bent knee sit-ups and push-ups each of the

six grade by sex groups at posttest has a higher pass rate than any same sex grade level at pretest. On the leg lifts and the head and chest lift either the posttest pass rate of a grade group exceeded that of other grades at pretest or they did not differ.

Three flexibility tests showed improvement at posttest. They are the back and hamstring flexibility, the head to feet crotch stretch and the soleus stretch. Again consideration of the full pattern of results presented here does not admit a simple maturational interpretation. On each of these items pass rates of fourth grade boys were lower than those of boys in earlier grades. Girls showed no grade level differences. On each of these tests the posttest pass rates of both boys and girls at each grade level either were significantly higher than the pretest pass rates of any grade level within the same sex group, or the two groups did not differ.

Impact of Feelin' Good Project

Ideally a health-fitness intervention program should impact students at several levels: awareness and understanding of the importance and interrelationship of health practices, nutrition, exercise and physical fitness. Then at the application level students should be guided to use their bodies to practice muscle strengthening and flexibility exercises and to monitor key body signs and to record pulse rate. The development of personal responsibility for maintaining body health should be an ongoing goal of teachers and adult leaders, and appropriate attitudes and values about health practices should be carefully cultivated.

It appears that the Feelin' Good project is an appropriate intervention program to involve children in the development of knowledge, skills, and positive attitudes and values about physical fitness. However, to be meaningful a program must be offered on a regular and frequent basis so that positive health and exercise habits are established and children learn to take personal responsibility for maintaining their own health. There was some evidence that this program did have a beneficial effect, but it obviously needed to be expanded , to have an impact on health and of motivating positive patterns of fitness.

Conclusions

In a technological society, such as ours, we have decreasing demands for physical exertion. The consequences are insufficient exercise which results in low muscle efficiency and lack of flexibility. These two factors have been related to the onset of debilitating diseases during childhood.

It appears that children come to school weak and inflexible, and the school makes little impact on this deficiency. By age 9, boys already show signs of stress and girls have not developed sufficient muscular strength. Yet it is also apparent that practice improves performance. In this investigation there was a pattern of improvement in performance from pretest to posttest on four muscle strength tests and three flexibility tests. Physical education leaders agree that exercise once per week is insufficient. To make a real difference in the performance of these subjects an exercise program should be implemented at least three times weekly. Invigorating activity of

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aerobic nature should incorporate corrective exercises along with appropriate health education concepts. Schools should not be dependent upon outside intervention projects to teach health and physical education. The health and physical education program in the schools should conform to state and national guidelines and be taught by classroom teachers on a daily basis.

Our knowledge base is insufficient to make judgments about the state of physical fitness of pre-schoolers. Yet it is apparent from this study that such an investigation is critical. Replication of this study with younger children and additionally with a focus on ethnic differences would provide valuable information concerning the physical fitness of young children.

TABLE I: Percent. passing minimum muscle strength test in each sex by grade group, pretest and posttest separately

	Boys		Girls	
	pre	post	pre	post
Straight leg sit-up:				
Grade 2	52.7	84.6	52.8	83.0
3	82.2	86.7	75.0	78.8
4	86.8	94.3	87.8	90.2
Bent knee sit-up:				
Grade 2	30.8	65.9	22.6	67.9
3	40.0	82.2	34.6	61.5
4	37.7	77.4	34.1	85.4
Leg lift:				
Grade 2	80.2	85.7	72.6	88.7
3	77.8	84.4	78.8	94.2
4	73.6	94.3	75.6	90.2
Head and chest lift:				
Grade 2	91.2	98.9	88.7	99.1
3	80.0	97.8	88.5	98.1
4	86.8	100.0	100.0	100.0
Head and chest lift from prone position with thighs off floor:				
Grade 2	63.7	72.5	52.8	73.6
3	60.0	80.0	57.7	69.2
4	60.4	84.9	70.7	87.8
Pushups:				
Grade 2	38.5	74.7	7.5	60.4
3	42.2	82.2	17.3	57.7
4	49.1	67.9	24.4	58.5

TABLE 2.: percent. passing flexibility test in each sex by grade group, pretest and posttest separately

	Boys		Girls	
	pre	post	pre	post
Straight knee toe touch:				
Grade 2	49.5	59.3	55.7	70.8
3	51.1	66.7	59.6	75.0
4	28.3	62.3	51.2	80.5
Spread-leg ear to knee:				
Grade 2	5.5	7.7	17.0	23.6
3	2.2	2.2	21.2	21.2
4	1.9	7.5	12.2	19.5
Head to feet crotch stretch:				
Grade 2	27.5	46.2	53.8	68.9
3	15.6	55.6	51.9	67.3
4	11.3	24.5	46.3	61.0
Knees to floor crotch stretch:				
Grade 2	6.6	6.6	4.7	12.3
3	4.4	2.2	15.4	25.0
4	5.7	5.7	14.6	14.6
Heel cord stretch:				
Grade 2	53.8	50.5	59.4	82.1
3	55.6	82.2	59.6	92.3
4	56.6	67.9	53.7	85.4
Shoulder flexibility:				
Grade 2	36.3	36.3	43.4	52.8
3	55.6	64.4	61.5	71.2
4	45.3	49.1	58.5	75.6

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TABLE 3 : X^2's, sex differences on flexibility tests, by grade level and time of measurement

	Pretest	posttest
Straight knee toe touch:		
Grade 2	--	--
3	--	--
4	4.21*	--
Spread-leg ear to knee:		
Grade 2	5.20*	7.96**
3	6.32**	6.32**
4	--	--
Head to feet crotch stretch:		
Grade 2	12.88***	9.48**
3	12.46***	--
4	12.78***	11.28**
Knees to floor crotch stretch:		
Grade 2	--	--
3	--	8.37**
4	--	--
Heel cord stretch:		
Grade 2	--	20.77***
3	--	--
4	--	--
Shoulder flexibility:		
Grade 2	--	4.78*
3	--	--
4	--	5.76*

*=p<.05; **=p<.01; ***=p<.001.

note: in each instance of significant difference, girls had a higher pass rate than boys.

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TABLE 4 : X^2's, grade level differences on flexibility tests, by sex and time of measurement

	Pretest	posttest
Straight knee toe touch:		
Boys	7.32*x	--
Girls	--	--
Spread-leg ear to knee:		
Boys	--	--
Girls	--	--
Head to feet crotch stretch:		
Boys	6.20*x	10.65**
Girls	--	--
Knees to floor crotch stretch:		
Boys	--	--
Girls	6.14*	--
Heel cord stretch:		
Boys	--	13.73**
Girls	--	--
Shoulder flexibility:		
Boys	--	9.79**
Girls	5.69*	8.88*

*=p<.05; **=p<.01; ***=p<.001.

x: children in lower grade performed better on this test than those in higher grades.

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TABLE 5 : Z's, improvement on minimum muscle strength tests by sex and grade level

	Boys	Girls
Straight leg sit-up:		
Grade 2	4.90	5.06
3	--	--
4	--	--
Bent knee sit-up:		
Grade 2	5.06	6.66
3	4.15	2.65
4	4.04	4.58
Leg lift:		
Grade 2	--	3.54
3	--	2.31
4	3.05	2.12
Head and chest lift:		
Grade 2	2.65	3.32
3	2.53	--
4	2.65	x
Head and chest lift from prone position with thighs off floor:		
Grade 2	--	3.48
3	--	--
4	2.98	--
Pushups:		
Grade 2	4.81	7.35
3	3.67	4.04
4	2.50	3.50

All z's shown are significant at the .01 level, one-tailed.

x: all subjects in this group passed the test both at pretest and at

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TABLE 6: Z's, improvement on flexibility tests, by sex and grade level

	Boys	Girls
Straight knee toe touch:		
Grade 2	--	2.74
3	2.11	--
4	4.02	3.21
Spread-leg ear to knee:		
Grade 2	--	--
3	--	--
4	--	--
Head to feet crotch stretch:		
Grade 2	3.05	3.02
3	4.24	2.31
4	2.11	--
Knees to floor crotch stretch:		
Grade 2	--	2.14
3	--	--
4	--	--
Heel cord stretch:		
Grade 2	--	4.12
3	3.21	3.71
4	--	3.15
Shoulder flexibility:		
Grade 2	--	--
3	--	--
4	--	2.33

All z's shown are significant at the .01 level, one-tailed.

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